



CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA
BERKELEY



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August 1938

KINGS RIVER BRANCH WATERSHED STUDY UNITS

An outdoor research laboratory dedicated
to the discovery of right principles of
watershed management to the end that the
maximum amount of usable water may be made
available for agricultural and urban use.

Circular Prepared By
S. M. Munson, August 1938

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BIG CREEK EXPERIMENTAL WATERSHEDS

WOODLAND - GRASS TYPE

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

KINGS RIVER BRANCH

AERIAL MOSAIC

MAY 1937

August 17, 1938

KINGS RIVER BRANCH

WATERSHED STUDY UNITS

California Forest and Range Experiment Station

I. CENTRAL CALIFORNIA'S NEED FOR WATERSHED MANAGEMENT

In the upper San Joaquin Valley of California south of the Chowchilla River there is a gross area of some 1,200,000 acres of irrigated land yielding agricultural products with an average annual value of over \$60,000,000. Investigations of the State Division of Water Resources have indicated that of this area 400,000 acres are in urgent need of a supplemental water supply. The available surface water, without reservoir storage, is now utilized to the maximum degree possible under existing laws and established water rights. There is also in some localities a serious overdraft on ground water supplies, which has contributed to the gravity of the problem. The net result has been that thousands of fertile acres have been thrown out of cultivation while other areas have suffered heavy loss of crops.

To remedy this situation, the Division recommended, and there is now under construction a system of dams, canals and water spreading grounds. The success of this program depends upon the availability of a dependable supply of silt-free water which, under favorable conditions, is obtainable from the mountain watersheds adjacent to the valley area. Since these mountain watersheds lie almost

entirely within national forest and national park boundaries, the Federal Government has a responsibility for their proper management. Such management must be based upon research to establish right principles for the desired objective.

A start on this research has been made by the California Forest and Range Experiment Station of the U. S. Forest Service by the establishment of a Branch Station in the Kings River Basin in the Sierra National Forest. This Station is initiating watershed studies which are described below.

II. THE KINGS RIVER BRANCH STATION WATERSHED STUDIES

A. Project Objectives

The objective of the watershed studies, broadly stated, is to determine the basis of management of woodland and conifer forest areas for the maximum yield and conservation of usable water for irrigation and other purposes. This will require study of present forest uses such as grazing, lumbering and recreation with a view first, to determine their effects on water supplies, and second, to integrate the uses in a system of management which will safeguard the mountain water supplies - the most valuable forest product of this region. The study includes also the effects of forest fires on water yield and erosion.

B. Project Status

The present program includes two groups of experimental watersheds located in representative cover type belts of the Sierra, as follows: (See page 8)

1. Big Creek Group

Cover type: Woodland-grass
Elevation Range: 1000 - 2150 feet
Area: 200 acres

2. Teakettle Creek Group

Cover type: Fir-pine
Elevation Range: 6400 - 8100 feet
Area: 1600 acres

The physical plant is now complete for the Big Creek group and collection of experimental data has begun. The Teakettle Creek group is still in the construction stage.

C. Experimental Procedure

Each watershed group will contain three or more watersheds similar in size and physiographic characteristics. It is planned to measure the performance of the various watersheds with regard to water yield and erosion under present use and under modifications of use. Following an adequate period of calibration in that manner, it is planned to manipulate the vegetative cover on all except one watershed (which will be reserved as a check) by various degrees of grazing, logging and burning. The effects of the various treatments will be reflected in the variations in yield of water and debris.

The data gathered by these studies include:

- a. Precipitation as rain and snow: volume, intensity and distribution.
- b. Water yield: seasonal and storm runoff, maximum and minimum flows and quality.
- c. Erosion: kind, volume and rate.

- d. Vegetation types: distribution, density, age and succession.
- f. Soils: types, depths, distribution, infiltration capacity, water holding capacity, etc.
- g. Topography: size and shape of watersheds, stream gradients, slope gradients, etc.

III. THE BIG CREEK WATERSHEDS (See frontispiece)

A. Description

The area is 43 miles northeast of Fresno, California, within the boundaries of the Sierra National Forest. It is situated in a representative portion of the woodland-grass cover type belt and comprises seven small watersheds varying in size from 21 to 36 acres. These watersheds are tributary to Big Creek which enters the main Kings River two miles above Trimmer. Their exposure is easterly and the elevation range is from 1000 to 2150 feet.

B. Hydrological Studies.

Precipitation, consisting chiefly of rainfall, is intensively measured in 100 rain gages. These gages are spaced approximately 200 feet apart on a system of contour trails traversing the study area at elevations 1200, 1450, 1700 and 1950 feet. Rainfall catch is measured in each rain gage at the end of every storm. Rainfall intensity is automatically recorded on charts by three weighing rain gages located at key points in the experimental area. (See page 9)

Three of the watersheds (Nos. 4, 5 and 6) have been equipped with control flumes, 90° V-notch weirs and concrete lined debris

reservoirs to measure maximum flood and erosion peaks expected under extremes of cover manipulation and use. The remaining four watersheds have been equipped with V-notch weirs and small masonry-lined reservoirs to measure flood and erosion peaks expected under moderate cover manipulation and use. Automatic instruments on the flumes and weirs provide continuous records of runoff. The reservoirs trap the eroded material for measurement as often as desired. (See illustrations, pages 10, 11 and 12)

C. Vegetation Studies

A detailed type map will be prepared of the existing vegetation in the seven watersheds together with a statistical analysis of each vegetation type to define its species composition and cover density. Periodic studies will be made as required to determine the vegetational changes resulting from natural causes and from use or manipulation.

D. Geological and Soil Studies

A detailed survey and map of the geological structure have been completed. A soil survey will also be made before any experimental treatment is begun.

IV. TEAKETTLE CREEK WATERSHEDS

A. Description

This area is in the fir-pine type of forest, 85 miles northeast of Fresno, California, in the Sierra National Forest. It comprises three 500-acre basins forming the headwaters of Teakettle

Creek which enters the North Fork of Kings River 25 miles above Trimmer. The exposure is easterly and ranges in elevation from 6500 to 8000 feet.

The plan of study is similar to that for the Big Creek watersheds with the exception that during the winter months rain gages will be replaced by snow measuring stations and snow gages. The study will include observation of the influence of forest cover upon snow accumulation, water content, rate of melting and evaporation.

V. HEADQUARTERS FACILITIES

Field headquarters to serve both watershed groups have been established near Trimmer. The facilities include a small dwelling, laboratory, garage, shop and several small utility structures.

VI. ACKNOWLEDGEMENTS

The project has been financed largely by the Works Progress Administration which has furnished the bulk of the necessary labor and materials through their District IV office in Fresno. Engineering designs and the inspection of construction were provided by the Forest Service through the San Francisco Regional Office. The Experiment Station selected the areas, developed the general plan for the project, and provided continuous supervision. Credit is due the Supervisors of the Sierra and Sequoia National Forests who have aided progress by the loan of men and equipment during periods of urgent need. Acknowledgement is also made to members of the Fresno Engineers Club for their valuable suggestions during the course of construction.

KINGS RIVER BRANCH

EXPERIMENTAL WATERSHED INSTALLATIONS

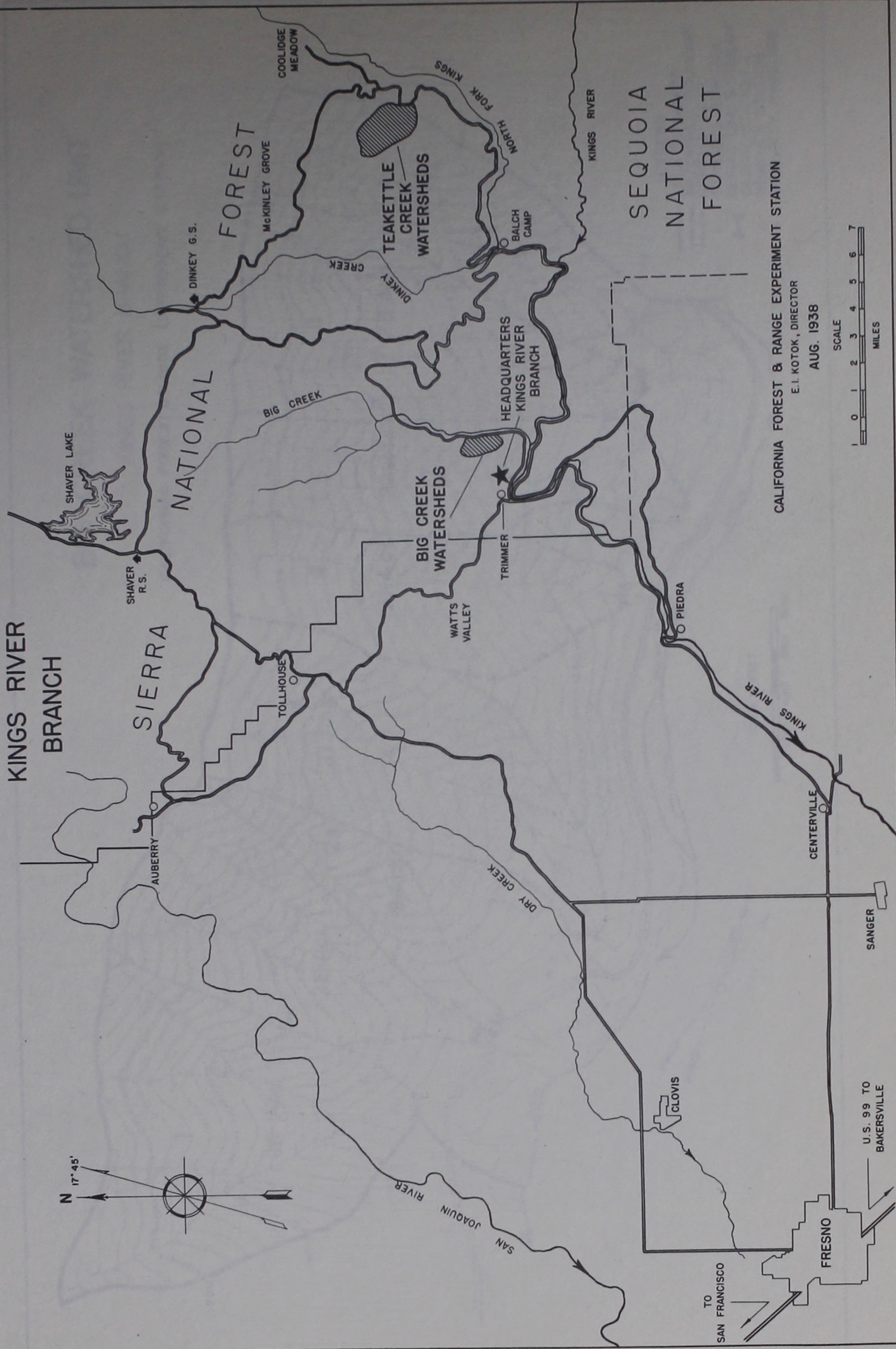
August 1938

| Watershed | Area Acres | Range in elevation Feet | No. of rain gages | | Stream gaging stations | | | Reservoir ^{1/} capacities cubic yards | Vegetation Type and major use |
|----------------------------------|---------------|-------------------------------|-------------------|-----------|---|----------------------|----------------------|--|---|
| | | | Standard | Intensity | Type | Size | Capacity Sec. Ft. | | |
| Big Creek Watersheds | 193 | 1000-2150 | 100 | 3 | | | | | Woodland-grass belt. (500 to 3500 ft.elev.) |
| No. 1 | 36 | 1010-1920 | 18 | | 90° Weir | 24" | 15 | 30 | |
| 2 | 22 | 1000-1980 | 12 | | 90° Weir | 24" | 15 | 30 | |
| 2a | 9 | 1000-1980 | 6 | | 90° Weir | 24" | 15 | 5 | |
| 3 | 31 | 1000-2050 | 16 | | 90° Weir | 24" | 15 | 35 | Digger pine, oak and grass - open country, used principally for grazing and fire wood production. |
| 4 | 21 | 1050-2050 | 12 | | Combina- tion 24" | 24" | 50 | 700 | |
| 5 | 22 | 1030-2080 | 10 | | weir and flume | Flume 18" | 40 | 500 | |
| 6 | 28 | 1120-2110 | 14 | | " | Flume 24" | 50 | 500 | |
| 7 | 24 | 1130-2150 | 12 | | 90° Weir | Flume 24" | 15 | 130 | |
| Teakettle Creek Watersheds | 1580 | 6400-8100 | 300 | 2/ 3 | Combina- tion 90° V and Cipol- letti weirs | 5' V & 6' Cip. | | | Fir-pine belt. (6500-8000 ft.elev.) |
| No. 13/ 2 | 490 | 6400-8000 | 100 | 2/ 2/ | | | 200 | 1000 | Chiefly red and white fir with a scattering of pines and cedar. |
| 3 | 542 | 6900-8100 | 100 | 2/ 2/ | | | 200 | 1000 | Potential lumber and pulp area. Present use grazing and recrea- tion |
| | 548 | 6700-8100 | 100 | 2/ 2/ | | | 200 | 1000 | |

^{1/} Estimated ^{2/} Combination rain gage and snow station ^{3/} Construction not started.

EXPERIMENTAL WATERSHEDS

KINGS RIVER BRANCH



CALIFORNIA FOREST & RANGE EXPERIMENT STATION

E.I. KOTOK, DIRECTOR

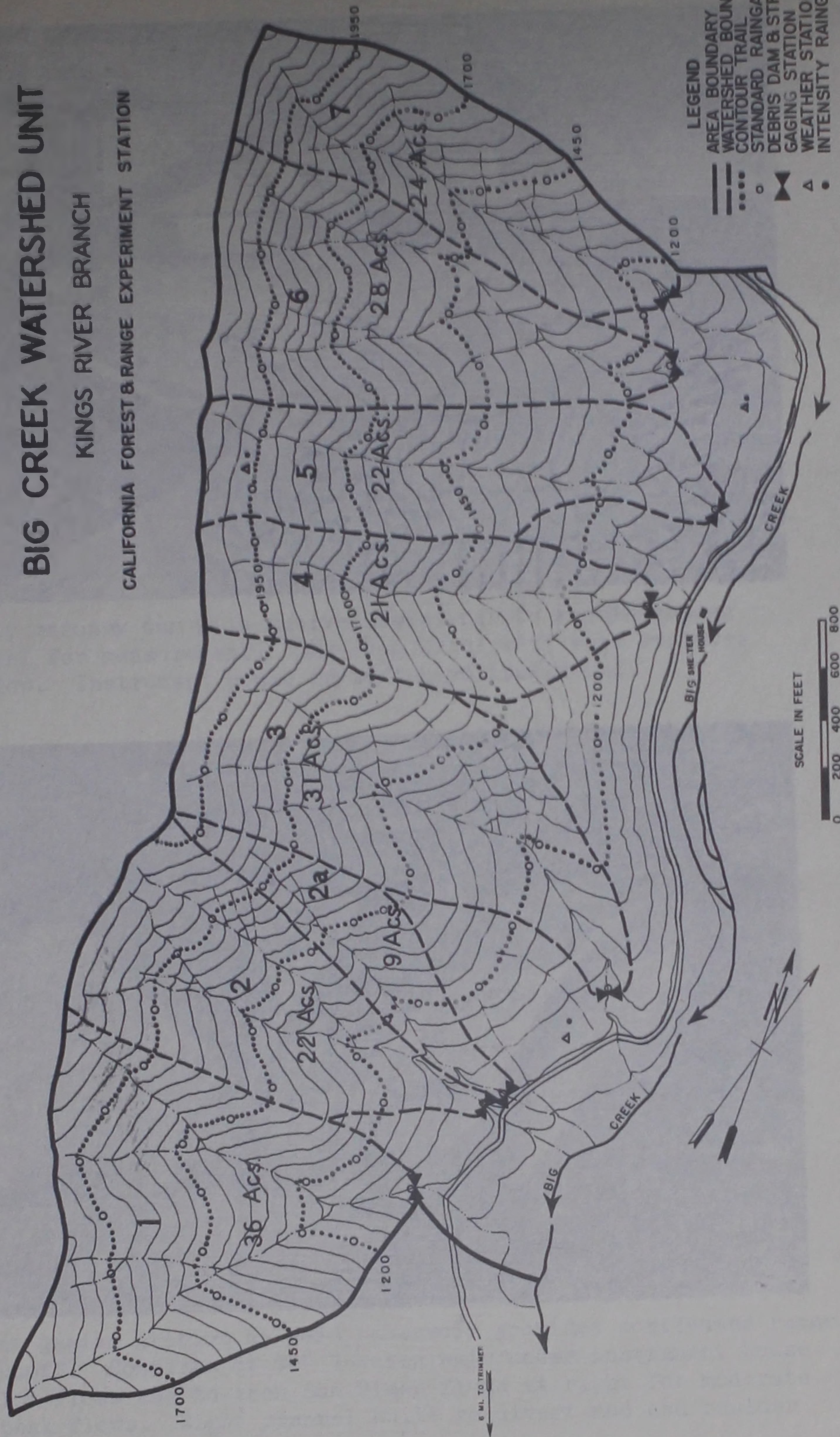
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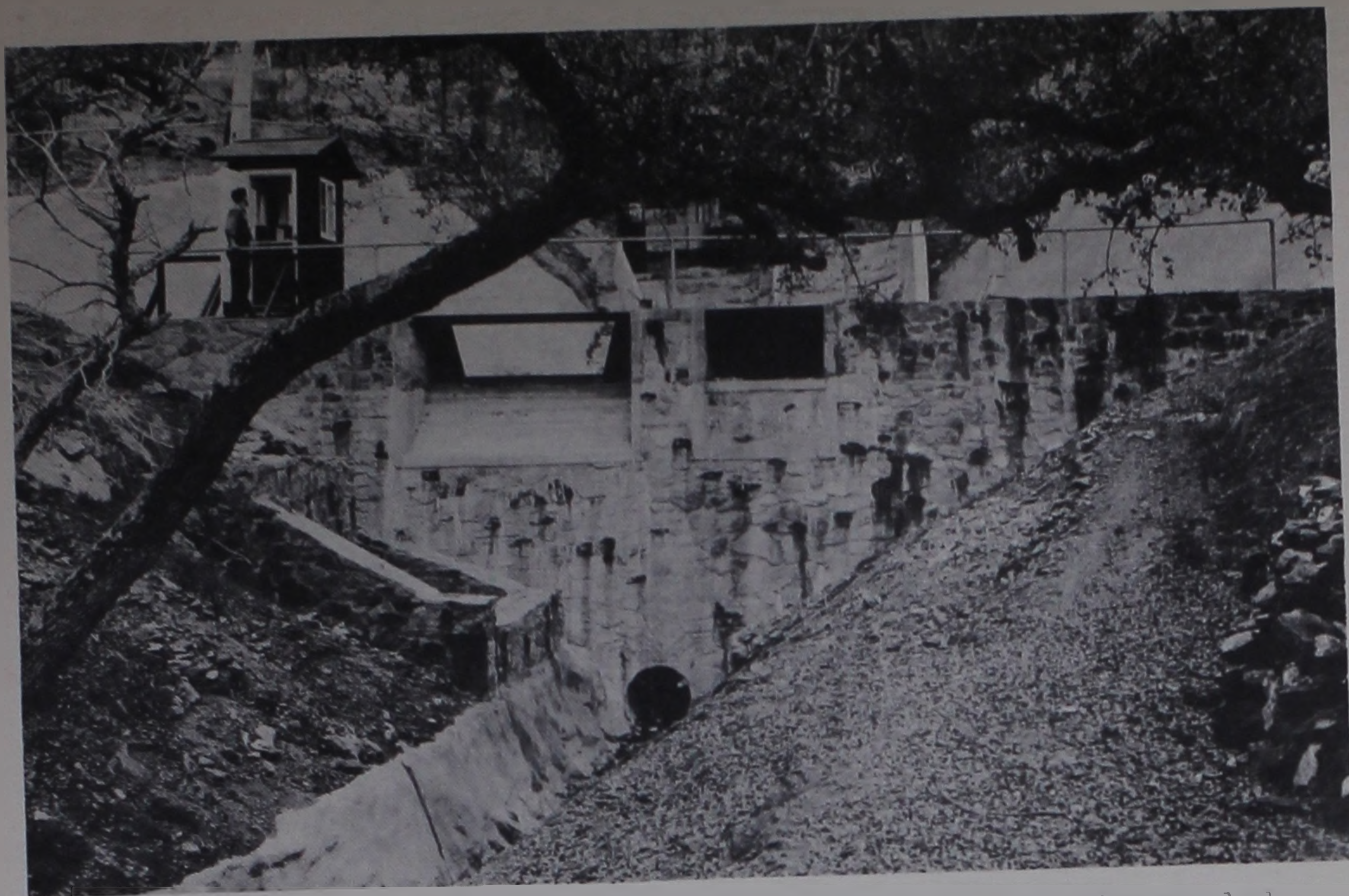
BIG CREEK WATERSHED UNIT

KINGS RIVER BRANCH

CALIFORNIA FOREST & RANGE EXPERIMENT STATION



INSTALLATIONS AT MOUTH OF 28-ACRE WATERSHED NO. 6,
BIG CREEK WATERSHEDS. TYPICAL OF UNITS TO MEASURE EROSION AND
MAXIMUM FLOOD PEAKS UNDER EXTREME COVER USE.



Gravity masonry dam with guniting reservoir to retain eroded material for measurement. Six-foot Cipolletti weir measures overflow. Instrument house in left-hand background.



Stream gaging station at head reservoir provides continuous record of runoff. Consists of 90° V-notch weir under instrument house for low flows and 24-inch San Dimas flume at right for moderate and peak flows. Right channel built to divert mud and boulder flows.



Upstream side of gaging station showing San Dimas type flume which provides continuous record of moderate and peak stream flows. Flume delivers water during these flows into reservoir shown in left-hand background. Low flows measured by 90° V-notch weir under instrument house. Masonry wall, right side, protects structure from mud and boulder flows.

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

E. I. Kotok, Director

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KINGS RIVER BRANCH

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